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INDUCED IR-ABSORPTION SPECTRUM OF GASEOUS NITROGEN

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Translation of "Indutsirovannyy spektr IK-pogloshcheniya gazoobraznogo azota", Academy of Sciences of the USSR, Moscow, Report, 1979, pp. 1-6.

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16. Abstract

Studied in the article was the induced infrared absorption spectrum of gaseous nitrogen. The coefficient of absorption of highly pure nitrogen was utilized to ascertain spectral dependence.

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INDUCED IR-ABSORPTION SPECTRUM OF GASEOUS NITROGEN

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The study of the induced absorption spectrum of nitrogen was carried out on a device which includes a multipass cell with a 1,216 m base, and a vacuum IR-spectrometer with a 300 graduation diffraction network, operating in the first order. In order to eliminate shortwave radiation, an interference filter was utilized. The portion of the scattered light did not exceed 1% in the transmission spectrum of the pumped out cell, and was taken into account during processing of the results. /1*

The spectral dependence of the coefficient of absorption of nitrogen was obtained in a temperature range from 130 to 300° K, the optical path varied from 5 to 50 m, the density of the gas changed within the range of from 13 to 33 AMAG and the spectral width of the slot did not exceed 0.8 cm^{-1}.

High purity nitrogen was subjected to additional purification in columns with KON[1] and adsorbents. The CO_2 content was successfully brought to a level which is not displayed in the spectrum. The only impurity which hinders registration proved to be carbon monoxide, the content of which, according to our determination, was a magnitude on the order of 10^{-5}%.

The coefficients of absorption $K(\nu)=(\rho^2 \ell)^{-1} \ln(J_0/J)$ in the region of wave numbers ν from 2,100 cm^{-1} to 2,642 cm^{-1} at room temperature ($T=293^{\circ}$ K) are given in the table, with a spacing, according to the wave numbers, of 2 cm^{-1}. The error

[1]KON—

*Numbers in the margin indicate pagination in the foreign text.

is determined according to the spread of the experimental values, obtained in different series of measurements.

The high-frequency wing of the zone ($\nu > 2{,}480$) is well described by the formula $K(\nu) = 0.911 \cdot 10^{18} \cdot \exp(-0.02249\nu)$ cm^{-1} $AMAG^{-2}$.

The values we calculated for the integral intensity of the zone $A = \int K(\nu)\, d\nu = (3.44 \pm 0.08) \cdot 10^{-4}$ cm^{-2} $AMAG^{-2}$, as well as the integral $\Gamma = \int \nu^{-1} K(\nu)\, d\nu = (1.46 \pm 0.03) \cdot 10^{-7}$ cm^{-1} $AMAG^{-2}$ agree well with the data in the literature. Given in study /2
[1] is the value $\Gamma = (1.51 \pm 0.01) \cdot 10^{-7}$ cm^{-1} $AMAG^{-2}$, and the value $A = 3.50 \cdot 10^{-4}$ cm^{-2} $AMAG^{-2}$ and given in study [2] is the value $\Gamma = 1.48 \cdot 10^{-7}$ cm^{-1} $AMAG^{-2}$.

With a change in temperature, as our investigations showed, with the spectrum $K(\nu)/\nu$, the following basically takes place:

1. the integral intensity $\Gamma(T)$ changes,
2. the breadth of the entire spectrum changes proportional to $\sqrt{T}$.

Thus, we managed, with a good degree of accuracy, to calculate the spectrum with a random temperature T from the spectrum obtained at room temperature, according to the following formula

$$K_T(\nu_0 + x) = \sqrt{\frac{293}{T}}\, K_{293}\left(\nu_0 + x\sqrt{\frac{293}{T}}\, \frac{\nu_0 + x}{\nu_0 + x\sqrt{\frac{293}{T}}}\right)$$

In the 250-300°K range, this expression makes it possible to calculate the spectrum with an accuracy of no worse than 2%.

REFERENCES

1. Shapiro, M. M., Gush, H. P., Canad. J. Phys., 44, 949 (1966).

2. Sheng, T., Ewing, G. E., J. Chem. Phys., 55, 5425 (1971).

Table of the coefficients of absorption K(ν) in units of 10^{-6} cm^{-1} $AMAG^{-2}$ for the induced spectrum of gaseous nitrogen in the region of wave numbers ν from 2,100 cm^{-1} to 2,650 cm^{-1} (zone $1 \leftarrow 0$) at a temperature of 293° K. 3

ν	K(ν)	ERROR %	ν	K(ν)	ERROR %
2I00	.04I		2I60	.I57	
2I02	.042		2I62	.I66	
2I04	.052		2I64	.I75	
2I06	.043		2I66	.I88	
2I08	.052		2I68	.I96	2-3
2II0	.05I	5-I0	2I70	.209	
2II2	.059		2I72	.2I3	
2II4	.056		2I74	.226	
2II6	.066		2I76	.233	
2II8	.060		2I78	.242	
2I20	.066		2I80	.255	
2I22	.063		2I82	.263	
2I24	.069		2I84	.28I	
2I26	.067		2I68	.285	
2I28	.073		2I88	.298	I,5-2
2I30	.073	4-5	2I90	.309	
2I32	.075		2I92	.320	
2I34	.076		2I94	.338	
2I36	.079		2I96	.343	
2I38	.08I		2I98	.36I	
2I40	.08I		2200	.374	
2I42	.084		2202	.384	
2I44	.093		2204	.40I	
2I46	.096		2206	.4I6	
2I48	.I06	3-4	2208	.427	I-I,5
2I50	.II0		22I0	.443	
2I52	.II9		22I2	.460	
2I54	.I25		22I4	.479	
2I56	.I38		22I6	.500	
2I58	.I44		22I8	.509	

ν	K(ν)	ERROR %
2220	.526	
2222	.543	
2224	.560	
2226	.576	
2228	.59I	
2230	.6I3	
2232	.630	
2234	.643	
2236	.664	
2238	.675	
2240	.699	
2242	.7I3	
2244	.728	
2246	.749	
2248	.760	
2250	.769	
2252	.784	
2254	.794	I-I,5
2256	.8I3	
2258	.829	
2260	.834	
2262	.845	
2264	.858	
2266	.863	
2268	.874	
2270	.88I	
2272	.893	
2274	.900	
2276	.9I8	
2278	.927	
2280	.935	
2282	.952	
2284	.963	
2286	.978	
2288	.993	

ν	K(ν)	ERROR %
2290	I.0II	
2292	I.027	
2294	I.052	
2296	I.077	
2298	I.I07	
2300	I.I44	
2302	I.I85	
2304	I.232	
2306	I.280	
2308	I.339	
23I0	I.390	
23I2	I.473	
23I4	I.545	
23I6	I,622	
23I8	I.682	
2320	I.736	
2322	I.802	
2324	I.846	I-I,5
2326	I.877	
2328	I.89I	
2330	I.907	
2332	I.897	
2334	I.873	
2336	I.820	
2338	I.793	
2340	I.766	
2342	I.703	
2344	I.637	
2346	I.576	
2348	I.528	
2350	I.468	
2352	I.424	
2354	I.397	
2356	I.36I	
2358	I.340	

ν	K(ν)	ERROR %
2360	I.322	
2362	I.305	
2364	I.303	
2366	I.29I	
2368	I.292	
2370	I.290	
2372	I.289	
2374	I.297	
2376	I.299	
2378	I.303	I-I,5
2380	I.309	
2382	I.3II	
2384	I.322	
2386	I.329	
2388	I.336	
2390	I.342	
2392	I.343	
2394	I.35I	
2396	I.337	
2398	I.345	
2400	I.346	
2402	I.348	
2404	I.329	
2406	I.333	
2408	I.330	
2410	I.326	
24I2	I.3I7	
24I4	I.3II	I
24I6	I.295	
24I8	I.277	
2420	I.262	
2422	I.25I	
2424	I,228	
2426	I.206	
2428	I.I93	
2430	I.I80	
2432	I.I59	
2434	I.I3I	
2436	I.I09	
2438	I.09I	
2440	I.06I	
2442	I.032	
2444	I.007	
2446	.979	
2448	.956	
2450	.930	
2452	.896	
2454	.873	
2456	.846	
2458	.8I8	
2460	.788	
2462	.763	
2464	.735	I
2466	.706	
2468	.685	
2470	.657	
2472	.633	
2474	.6I0	
2476	.588	
2478	.564	
2480	.540	
2482	.5I9	
2484	.498	
2486	.476	
2488	.457	
2490	.437	
2492	.4I7	
2494	.40I	
2496	.382	
2498	.367	

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ν	K (ν)	ERROR %
2500	.350	I
2502	.337	
2504	.3I6	
2506	.305	
2508	.292	
2510	.277	
2512	.266	
2514	.254	
25I6	.242	
2518	.232	
2520	.2I9	I-I,5
2522	.2II	
2524	.20I	
2526	.I94	
2528	.I85	
2530	.I75	
2532	.I67	
2534	.I59	
2536	.I53	
2538	.I45	
2540	.I40	I,5-2
2542	.I35	
2544	.I29	
2546	.I25	
2548	.I2I	
2550	.II5	
[illegible]	.I09	
2554	.I03	
2556	.097	
2558	.093	
2560	.090	2-3
2562	.086	
2564	.08I	
2566	.079	
2568	.074	
2570	.072	
2572	.070	2-3
2574	.066	
2576	.063	
2578	.06I	
2580	.057	3-4
2582	.055	
2584	.053	
2586	.05I	
2588	.049	
2590	.046	
2592	.044	
2594	.043	
2596	.040	
2598	.040	
2600	.038	4-6
2602	.038	
2604	.034	
2606	.032	
2608	.03I	
26I0	.029	
26I2	.028	
26I4	.027	
26I6	.025	
26I8	.024	
2620	.024	6-I0
2622	.023	
2624	.020	
2626	.020	
2628	.0I9	
2630	.0I8	
2632	.0I7	
2634	.0I6	
2636	.0I5	
2638	.0I5	
2640	.0I5	
2642	.0I4	

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